# EXPERIMENTAL EVALUATION OF THE PERFORMANCE OF A HYBRID ARTIFICIAL CORAL REEF WITH BRAIN AND STAGHORN CORALS

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Considering that more than 40% of the world's population resides within 100 km of coastal areas [WRI, 2007], the protection of coastal communities is critical. Coral reefs provide a large variety of ecosystem services from fishing, recreation and tourism to coastal flood risk reduction to nearby populations. They act as a green, self-building and self-repairing breakwaters dissipating wave energy through wave breaking and bed friction [Beck, 2018]. However, coral reefs are not typically accounted for as a coastal infrastructure as their effects are not easy to quantify [Ferrario, 2014] as their interaction with waves depends on multiple parameters including the variable morphologies of the organisms that form the reef. In this study, the wave energy dissipation of a scaled reef model with two coral species (staghorn and brain corals) of variable cover was evaluated through a series of laboratory experiments at the University of Miami SUrge STructure Atmosphere INteraction (SUSTAIN) Facility, a wind/wave tank with hurricane capabilities. A scaled coral reef model (Fig. 1) was tested under the direct impact of swell and hurricane generated waves considering Froude similarity with a prototype reef in South Florida. The results show that the coral reef model can reduce the incident wave energy by up to 98% with the coral contribution estimated to be up to 56% of the total wave energy dissipation depending on hydrodynamic conditions (water and wave conditions) and the physical characteristics of the reef (reef profile, width, surface roughness, and height). Staghorn corals were found to dissipate more wave energy compared with brain corals with coral cover playing an important role for both species. The results of this study can guide coral friction estimates improving thus coastal numerical models focused on exploring coral reefs for shoreline protection while guiding also coral restoration efforts for coastal resilience.

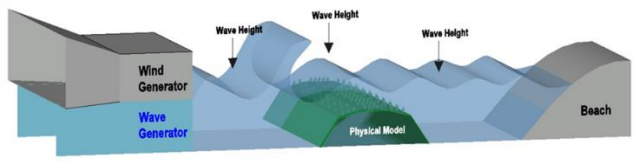


Figure 1 – Illustration of the experimental set-up for the evaluation of the wave reducing capacity of a hybrid artificial coral reef model with brain and staghorn corals.

REFERENCES

World Resources Institute (WRI), Fisheries (2007) Population within 100 km of coast.

Beck, Losada, Menéndez, Reguero, Díaz-Simal, Fernández, (2018): The global flood protection savings provided by coral reefs. Nature communications, 9(1), pp.1-9.

Ferrario, Beck, Storlazzi, Micheli, Shepard, and Airoldi, (2014): The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature communications, 5(1), pp.1-9.